Section 1
Introduction

This report, prepared in coordination with the North Bay Water Reuse Authority (Authority), presents an engineering evaluation and an economic and financial analysis of a proposed project for a regional approach to recycled water distribution in the North San Pablo Bay area of California.

The report has been prepared by the Authority's consultant, Camp Dresser & McKee Inc. in partial fulfillment of the requirements of the U. S. Department of the Interior's Bureau of Reclamation Public Law 102-575, Title XVI (the Reclamation Wastewater and Groundwater Study and Facilities Act of 1992, as amended). Title XVI provides a mechanism for Federal participation and cost-sharing in approved recycled water projects and provides general authority for appraisal and feasibility studies.

The Authority, established under a Memorandum of Understanding (MOU) in August 2005, is comprised of the Sonoma County Water Agency (SCWA), as Administrative Agency, together with four wastewater utilities as member agencies – the Las Gallinas Valley Sanitary District (LGVSD), the Novato Sanitary District (Novato SD), the Sonoma Valley County Sanitation District (SVCSD), and the Napa Sanitation District (Napa SD). North Marin Water District (NMWD) and Napa County are providing technical and financial support to the Authority.

Under the MOU and its amendment, the Authority is exploring "the feasibility of coordinating interagency efforts to expand the beneficial use of recycled water in the North Bay Region thereby promoting the conservation of limited surface water and groundwater resources." The proposed North San Pablo Bay Restoration and Reuse Project (Project), the subject and intended outcome of the Authority's work, would alter the disposition of wastewater in the North Bay Region by reducing the volume of treated wastewater discharged into San Pablo Bay and its tributaries and instead providing increased recycled water supply to agricultural, urban, and environmental uses.

This report describes the proposed Project area and the key water management issues and needs within this Project area, identifies recycled water opportunities in the Project area, develops and analyzes alternative measures that could address the identified water management needs, presents an economic and financial analysis of the Project, and presents an overview of associated legal and institutional requirements.

This report is the product of the Phase 3 effort in a three-phase approach adopted by the Authority. The Phase 1 engineering foundation report, completed in March 2005, represented the submittal of initial results – preliminary information on demands in the study area, possible project configuration, and preliminary cost estimates. The Phase 2 report, completed in June 2006, presented a more detailed engineering development and evaluation of best agreed alternatives. This Phase 3 report has refined the engineering evaluation, and includes the economic analysis of alternatives and documentation of the financial capability of the participating agencies. The Environmental Impact Statement/Environmental Impact Report (EIS/EIR) is underway and will be concluded in mid-2009, thereby completing the feasibility study report in fulfillment of Title XVI requirements.

1.1 Background

Four wastewater treatment agencies and one drinking water provider in the North San Pablo Bay area have joined together to investigate the use of recycled water for agricultural, environmental, and urban uses. The study area includes diked marsh, tidal marsh, and upland areas that rim the northern edge of San Pablo Bay. The complex area includes sensitive environmental areas, major urban areas, and one of the most prominent wine-producing regions in California.

As North San Pablo Bay area populations expand and environmental regulations grow more stringent, local municipalities are considering new ways to make use of recycled water. At the same time, urban and agricultural interests are searching for reliable water supplies.

In September 2002, SCWA entered into a cooperative agreement with the U.S. Department of the Interior Bureau of Reclamation (Reclamation) to prepare a feasibility study under the requirements of Reclamation's Title XVI program, which defines a program to investigate and identify opportunities for reclamation and reuse of municipal, industrial, domestic, and agricultural wastewater, and naturally impaired groundwater and surface waters.

From the beginning of the effort, local wastewater agencies were invited to attend meetings and provide input. Four of these agencies eventually joined SCWA as signatories to an MOU establishing the Authority, and provided a share of the local financial contribution toward completion of the Title XVI feasibility study.

The North San Pablo Bay Restoration and Reuse Project Phase 3 Engineering and Economic/Financial Analysis Report (Report) is being conducted under Section 1604 of Title XVI, which provides general feasibility study authority. The Report follows Reclamation's "Guidelines for Preparing, Reviewing, and Processing Water Reclamation and Reuse Project Proposals Under Title XVI of Public Law 102-575, as Amended" (Reclamation undated), and Reclamation Manual Directives and Standards WTR 11-01, "Title XVI Water Reclamation and Reuse Program Feasibility Study Review Process" (Reclamation 2008). The complete feasibility study report (a combination of this report and the EIS/EIR) will provide decision-makers with the information needed to make an informed choice regarding implementation of a recommended project.

The Project partners are completing the feasibility study in a phase approach, as shown below.

1.2 Project Purpose

The Project would create a regional wastewater reuse project to provide recycled water for agricultural, urban, and environmental uses as an alternative to discharging treated wastewater to San Pablo Bay and to developing other water supplies to meet current and future needs. The Project would also contribute to mitigation for groundwater basin overdraft in some portions of the study area. In this way, the wastewater discharge issues and water demand issues of the region can be addressed in an integrated and synergistic manner.

1.3 Participants

A regional program can provide broader benefits than individual projects, and multiple political representatives can provide a broad political base of support for the Project. With SCWA as the Administrative Agency, several wastewater treatment agencies in the North Bay are partners in the Project. The following agencies and wastewater treatment facilities, addressed from west to east, are participating in the feasibility analysis:

- ***LGVSD*** – The LGVSD wastewater treatment plant (WWTP) provides sanitation service to approximately 30,000 people within the area of Marinwood, Lucas Valley, Terra Linda, Santa Venetia, Los Ranchitos, and Smith Ranch Road (LGVSD 2005).

- ***Novato SD*** – The Novato WWTP provides service to approximately 60,000 residents within the City of Novato, an area of 28 square miles, and surrounding areas (Novato SD 2006).

- ***SVCSD*** – The SVCSD WWTP began operations in 1954 and provides service to approximately 34,000 residents around the City of Sonoma and unincorporated areas of Glen Ellen, Boyes Hot Springs, and Agua Caliente, within a 7-square-mile area (SVCSD 2006).

- ***Napa SD*** – The Napa SD's Soscol water recycling facility treats wastewater from the City of Napa and surrounding unincorporated communities, an area of about 23 square miles, and serves about 33,000 connections (Napa SD 2006).

SCWA, which began the Title XVI process for investigating a recycled water distribution system under Cooperative Agreement with Reclamation, is a drinking water provider and continues to be an actively participating partner and the Administrative Agency for the Authority. NWMD and Napa County are providing technical and financial support to the Authority.

The City of Petaluma is not a signatory to the MOU establishing the Authority, but the City's participation in the regional recycled water system was initially evaluated in the early stages of the feasibility study (through Phase 2) prior to the Authority receiving notice that the City did not wish to participate.

The Marin Municipal Water District (MMWD) service area was also initially evaluated for inclusion in the Project. After Phase 2 of the Project analysis, MMWD indicated to the Authority it was no longer interested in having the Project serve recycled water within an expansion of its service area.

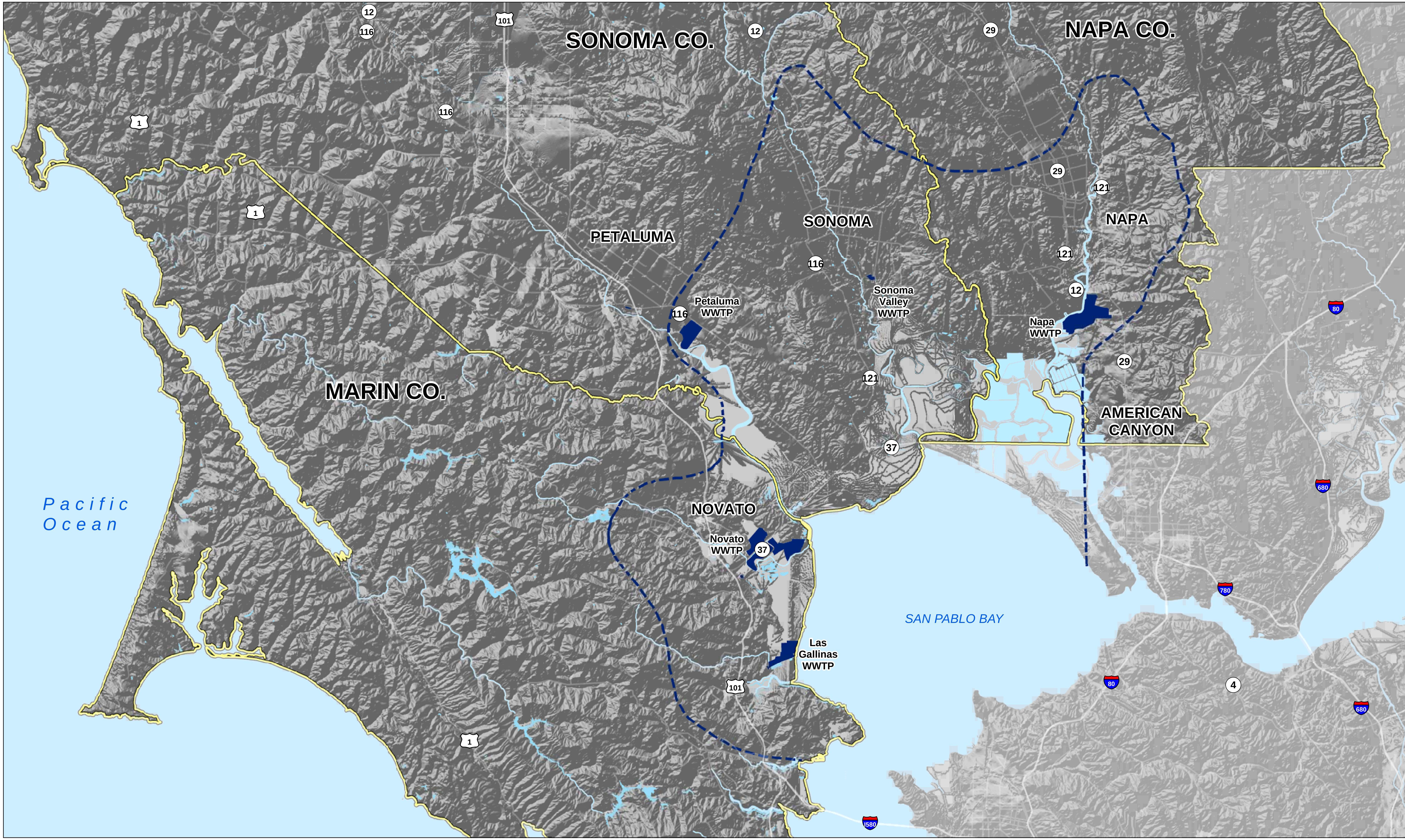
For the purposes of presenting a complete account of the Project's feasibility study process, Petaluma and MMWD remain included in the Report's discussions of the initial study area (see Sections 1.4, 2, and 3), water reuse opportunities (see Section 4), and initial alternatives screening (see Section 5). Section 5.4 presents the final selection of action alternatives, and discusses how Petaluma and MMWD have been removed from further evaluation.

1.4 Study Area

The initial study area, illustrated in Figure 1-1, extends approximately 10 to 15 miles inland from the San Pablo Bay within Marin, Sonoma, and Napa Counties. The study area extends as far south as Point San Pedro in Marin County, and as far north as Milliken Canyon located 28 miles to the northeast in eastern Napa County, and encompasses about 318 square miles of land. Urban centers in the study area are San Rafael (county seat) and Novato in Marin County, Petaluma and Sonoma Valley in Sonoma County, and Napa (county seat) in Napa County. The populations of San Rafael, Novato, Petaluma, Sonoma Valley, and Napa in 2005 were 69,000, 53,700, 57,700, 34,000, and 80,300, respectively.

The topography of the study area consists of gently sloping river valleys, separated by northwest trending mountain ranges with steep slopes and peaks exceeding elevations of 2,500 feet above mean sea level. Flat lying mudflats and marshland border San Pablo Bay. The majority of the study area is within Napa, Sonoma, Petaluma, and Novato Valleys and the foothills bounding these valleys.

The study area receives water from sources both inside and outside the region. Water sources within the region include the Napa River, Petaluma River and Sonoma Creek (used for agricultural supplies), and Stafford Lake on Novato Creek. Surface water sources outside the region include the Russian River Project (including Lake Mendocino, Lake Sonoma, and imports from the Eel River via Pacific Gas & Electric Company's Potter Valley Project), Lake Hennessey, Milliken Reservoir, MMWD's six



Basemap: U.S. Department of Agriculture, 2001

Legend

- Initial Study Area Boundary
- WWTPs

0 2.5 5 10
Miles

N

CDM

Figure 1-1
Initial Study Area

Lagunitas Creek watershed reservoirs, Soulajule Reservoir, and the Sacramento-San Joaquin Delta via the State Water Project. The region relies on groundwater and recycled water as additional sources.

In undertaking the Project's Feasibility Study, the following features of the study area were taken into consideration:

- The five initial municipal wastewater agencies and their existing users of recycled water;
- Existing or future agricultural, urban, recreational, industrial, or environmental land uses that could benefit from the use of recycled water;
- Existing or future infrastructure that will be required for the treatment, conveyance, or storage of recycled water;
- Existing or planned local recycled water projects that would benefit from incorporation into the Project; and
- Land uses whose relative locations support an economically justifiable distribution system.

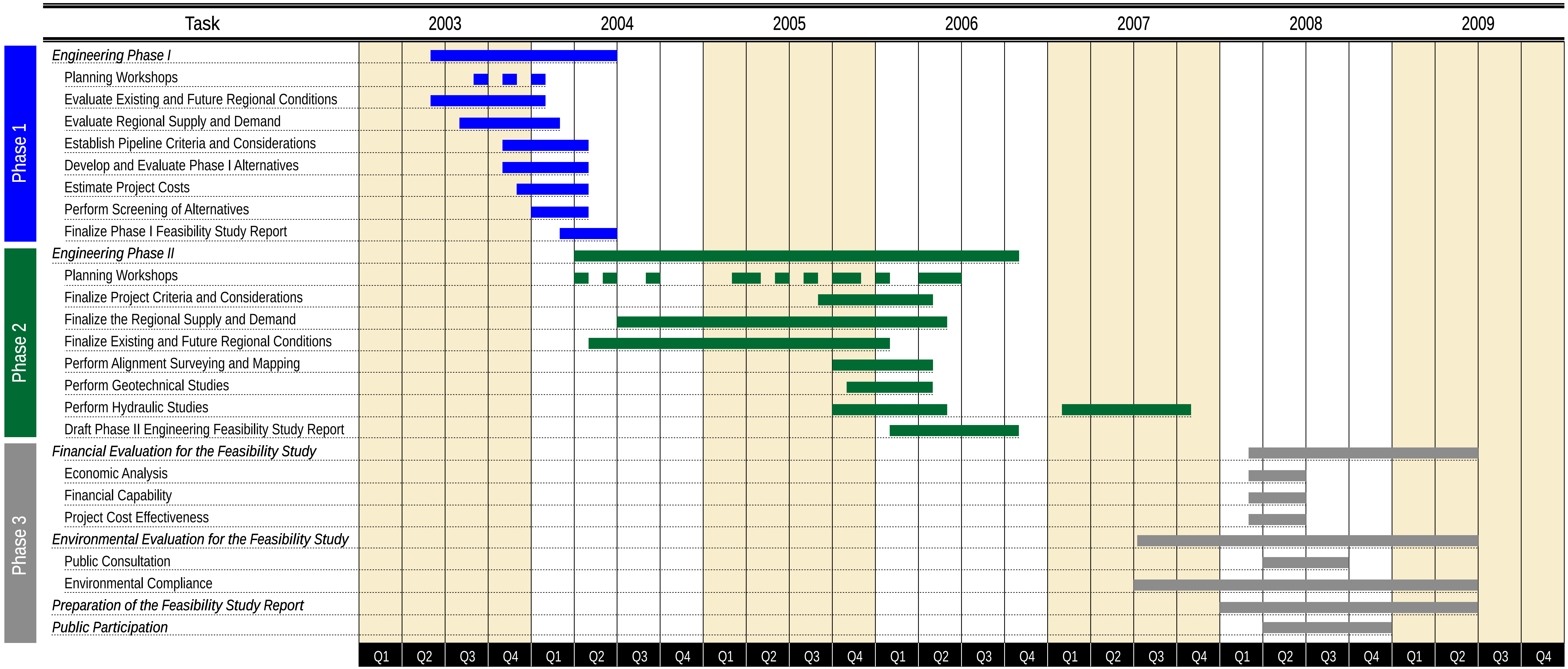
1.5 Planning Process

1.5.1 Overview

This Project is a regional program with multiple participants. Establishing a process to incorporate the thoughts and viewpoints of all participants was critical to the success of the Project. Additionally, the Project involves delivering recycled water to a wide range of potential customers whose concerns must be addressed throughout the planning process. Establishing a documented planning process gave each participant the opportunity to understand and contribute to each of the steps, allowing participants to better understand the outcome of the process. The Feasibility Study work schedule for 2003 through 2009 is detailed in Figure 1-2. The figure shows the tasks and schedule for each phase of the Project.

1.5.2 Workshops

The participating agencies initiated a series of bi-monthly technical workshops. The first three workshops constituted Phase 1 while the 16 subsequent workshops fell under Phase 2. Table 1-1 summarizes the discussions at each of the technical workshops.



W:\REPORTS\SCWA\North San Pablo Bay Restoration and Reuse Project\Graphics\Figure 1-2_Feasibility Study Work Plan Schedule.ai 04/30/08

Figure 1-2
Feasibility Study Work Plan Schedule
NORTH SAN PABLO BAY RESTORATION AND REUSE PROJECT

CDM

Table 1-1 Summary of Technical Workshops		
Workshop Number	***Date***	***Discussion Progress***
1	September 2003	• Identified the Project areas of concern including: institutional/regulatory, economic/financial, water supply, and natural resources
2	November 2003	• Discussed existing and future regional conditions • Discussed regional supplies and demands • Considered options for the Project, which included projects, programs, or policies that serve as building blocks for complete alternatives
3	January 2004	• Discussed the preliminary formulation of alternatives • Considered how the options from the last workshop fit together into alternatives • Formulated action alternatives
4	April 2004	• Discussed preliminary alternative costs • Presented methodology to narrow the potential storage and treatment options within each alternative
5	June 2004	• Distributed Draft Phase 1 Feasibility Report • Discussed schedule and message for future grower outreach meetings • Discussed scope of the No Project alternative and regional program examples
6	September 2004	• Update on institutional issues such as the MOU between participants and cost sharing methods for Phase 2 work
7	December 2004	• Presented revisions to the Draft Phase 1 Feasibility Report • Considered methods for cost share agreement and schedule of payments • Discussed activities related to Proposition 50 studies
8	March 2005	• Refined schedule and scope of work for Phase 2 activities • Discussed specifics of cost share agreement
9	April 2005	• Discussed existing recycled water projects underway in the study area • Considered various data sources for land use information • Identified potential recycled water supplies from the participating agencies
10	June 2005	• Considered cost allocation methodologies • Presented land use maps for review by participants • Discussed conceptual alternatives
11	August 2005	• Discussed refinements to the project alternatives, including storage options • Revisited evaluation criteria
12	October 2005	• Presented final alternatives and early pipeline layouts • Considered phasing of alternatives based on cost (or proximity to plants), readiness-to-proceed, and equity
13	November 2005	• Discussed details (service area, demand, cost) of locally-developed recycled water projects • Presented refined alternative pipeline layouts
14	January 2006	• Discussed initial hydraulic modeling activities • Distributed draft outline of the Phase 2 report • Reviewed storage options and construction cost curves
15	April 2006	• Distributed draft technical memorandum on supply/demand and geotechnical information for inclusion in the Phase 2 report • Discussed status of hydraulic modeling of the alternatives • Considered options for the No Project alternative

Table 1-1
Summary of Technical Workshops

16	May 2006	• Distributed draft technical memorandum on hydraulic modeling and regional conditions for inclusion in the Phase 2 report • Discussed system operations assumed in modeling
17	June 2006	• Distributed draft Phase 2 Engineering Feasibility Study Report
18	April 2007	• Presented analysis of revised hydraulic modeling for one alternative
19	July 2007	• Discussed additional revisions to Alternative 1

The early technical workshops focused on defining the stakeholder interests and concerns for the Project, establishing the existing conditions, and determining the recycled water supply and demand. An important early output was the agreed array of planning concerns and issues developed by the participating agencies, as shown in Figure 1-3. These consensus-based issues and concerns provided insights during the following analysis.

Parallel to the technical workshops, Project participants are attending monthly institutional workshops to:

- Determine levels of control allocated to each Project sponsor (agencies and WWTPs);
- Pursue funding opportunities; and
- Determine ownership of the recycled water.

Section 7.1 discusses the MOU signed, and amended, by the member agencies and the potential future formation of a Joint Powers Authority. Under the Joint Exercise of Powers Act, California Government Code 6502, two or more public agencies by agreement may jointly exercise any power common to the contracting parties.

1.5.3 Public Outreach

Concurrent with the technical workshops and feasibility study activities, the member agencies initiated public outreach efforts to collect grower or end user information at a broad scale within each member agencies' service area. Outreach meetings were conducted which identified potential Project participants, discussed grower concerns and needs, reviewed land use mapping for accuracy, and discussed projected future changes in the agricultural industry within each service area. The outreach efforts are developing agricultural reuse contacts and working towards securing commitments to use recycled water. As Project activities carry on, potential users will continue to be invited to periodically attend Authority meetings and meetings with other growers and local industry representatives, and review handouts or reports. Recent public outreach efforts include a series of stakeholder meetings in the study area to introduce the Project to the general public, and development of the Authority's Project website, to provide information to the public on the Authority and the status of the Title XVI feasibility study process.

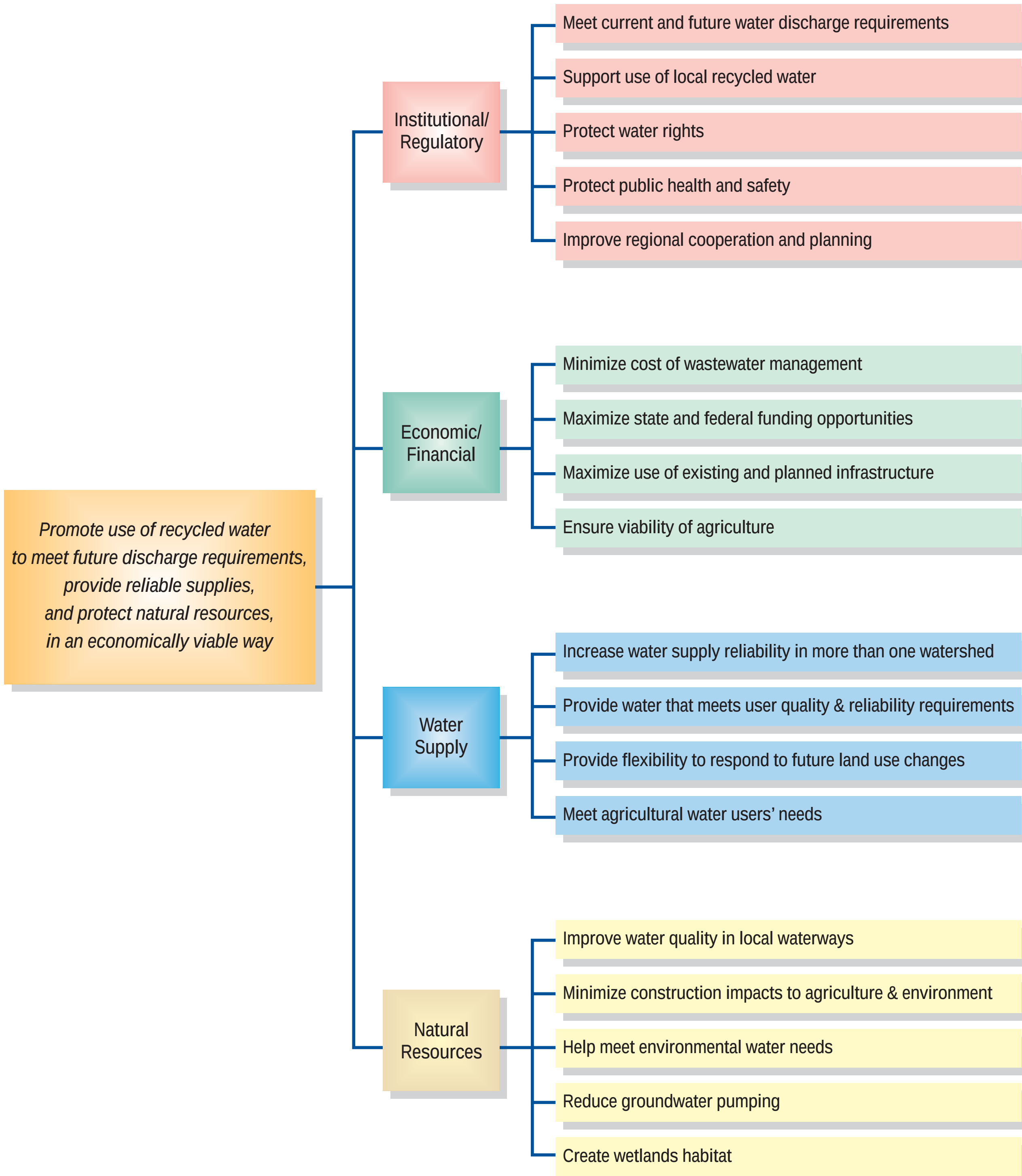


Figure 1-3
Planning Issues and Concerns

1.6 Document Organization

The Phase 3 report is organized into 12 sections:

- ***Section 1*** provides an introduction and background information on the Project.
- ***Section 2 - Problems and Needs*** identifies the fundamental issues that caused the agencies to pursue a regional recycled water project, and regional demands and supplies.
- ***Section 3 - Existing and Future Regional Conditions*** evaluates the existing physical and environmental conditions of the study area that would be potentially affected by the Project, and discusses the potential future of the region without the Project.
- ***Section 4 - Recycled Water Opportunities*** describes the WWTPs that will potentially contribute to the Project's recycled water supply.
- ***Section 5 - Formulation of Initial Alternatives*** discusses the method used to develop the Project alternatives.
- ***Section 6 - Description of Alternatives*** defines the Project alternatives, including a No Action alternative.
- ***Section 7 - Legal and Institutional Requirements*** presents the status of the agencies' working agreement, future consultation activities, and regulatory requirements.
- ***Section 8 – Recommended Alternative*** reviews the problems, needs, supplies, demands, costs, benefits, and tradeoffs of the alternatives, and presents the recommended Title XVI alternative.
- ***Section 9 – Economic and Financial Analyses*** provides the economic comparison of the recommended alternative to other water supply alternatives, the life-cycle cost analysis, and discusses the financial capability of the partner agencies.
- ***Section 10 – Environmental Considerations*** provides information potential environmental impacts from the Project.
- ***Section 11*** presents ***Research Needs*** for the Project.
- ***Section 12 - References*** identifies a list of the references used in the Phase 3 document.

The organization and content of the above sections has been prepared with the intent to meet the Feasibility Report Outline recommended by the Title XVI program. The EIS/EIR, the last element required by the Title XVI process, will be added to finalize the feasibility study following its completion in 2009.

Section 2
Problems and Needs

The agencies of the North Bay Water Reuse Authority (Authority) have undertaken this feasibility study of the North San Pablo Bay Restoration and Reuse Project (Project) because they recognize the need to address mounting environmental, regulatory, and water supply concerns. The first part of this section identifies the water management needs within the study area which have led the member agencies to investigate increased use of recycled water. The second part of this section elaborates on the water supply problem by describing water supplies and demands in the region.

2.1 Water Management Needs

The study area of the North San Pablo Bay is unique because of the mix of sensitive environmental areas, growing urban areas, and high-value agricultural areas. Each of these constituent areas is affected by existing water management needs and will be exposed to increasing challenges in the future.

The issues and needs can be summarized as follows:

- The agricultural economy, which is dominated by high-value vineyard culture, requires a highly reliable water supply to maintain and expand its crop base.
- Urbanization of the greater San Francisco Bay area requires highly reliable sources of water.
- The vitally important estuarine ecosystem of the North San Pablo Bay area, which includes endangered species and vital wetlands, has been under intense pressure. Although protective and restorative measures are in place, the habitat requires a reliable supply of water.
- Surface water supplies are less reliable sources of supply as they are already diverted by multiple users, have low flows in the summer (which coincides with the irrigation season), and can have low flows in dry years.
- Groundwater supplies are heavily pumped for agricultural and municipal uses and in some localities have marginal quality.

These topics are all among those addressed in the planning issues and concerns identified by the participating agencies (Section 1, Figure 1-3). The following pages present more detail on the water management needs of the North San Pablo Bay area.

2.1.1 Water Supplies in the Study Area

The study area includes some of the premier wine grape-growing regions in North America and is part of the desirable and rapidly growing San Francisco Bay area. Both of these factors exert pressure on water supplies; both need highly reliable water supplies to maintain and expand the economies in the region.

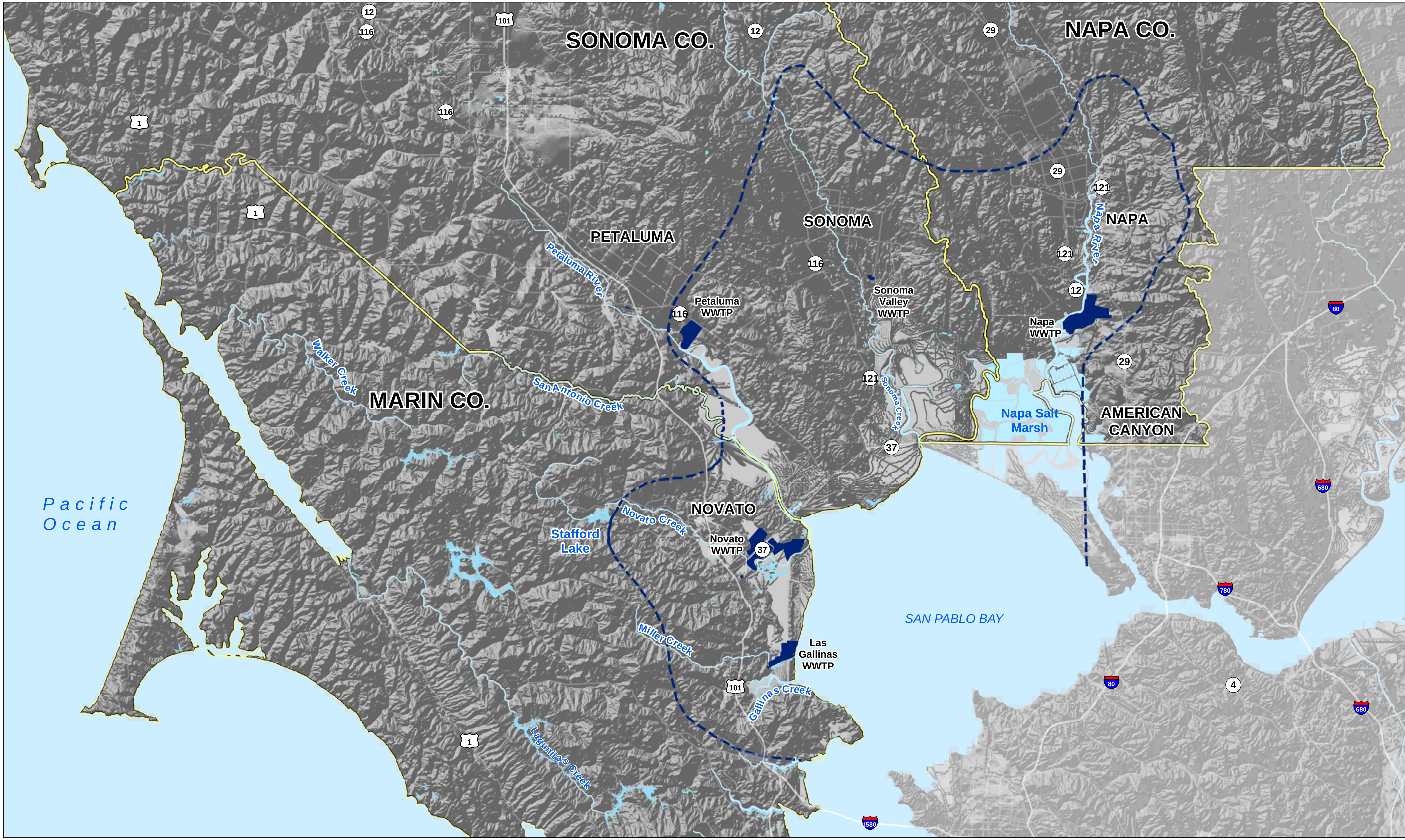
Water supplies in the study area are drawn from both surface water and groundwater sources. The region has three main waterways (Napa River, Sonoma Creek, and Petaluma River), shown in Figure 2-1, and many smaller tributaries to these waterways. Some agricultural users divert water from surface streams that are ephemeral or have very low flows during the summer. These supplies are not reliable during dry years. Current surface water supplies and quality are discussed further in Section 2.2.2.1.

Groundwater is a primary water supply for agricultural users and a supplemental supply for urban users. Groundwater yields vary depending on location, but yields in the foothills (where many new vineyards are being planted) are low. Additionally, the deteriorating quality of some groundwater sources is a concern. The groundwater aquifer in parts of Sonoma and Napa Counties, for example, has localized concentrations of boron and salinity that make the groundwater unusable for agricultural uses and in some cases for urban uses. Current groundwater supplies and quality are discussed further in Section 2.2.2.2.

Agricultural productivity and costs could be affected if groundwater becomes an unreliable water supply for farmers. In urban areas, water agencies would need to find another, potentially costly, water source to supplement surface water resources if groundwater resources were compromised. To address this problem, the region needs a reliable and supplemental source of water supply, such as recycled water, that agriculture can count on and that urban areas can employ to save valuable potable water for municipal users.

2.1.2 Water Quality

Water quality is a problem for both groundwater and surface water in certain parts of the North Bay study area. These supplies serve environmental, agricultural, and urban water needs, yet neither source is a dependable option due to water quality concerns. Groundwater basins close to the San Francisco Bay, including Sonoma and Napa Counties, have areas of high total dissolved solids and chloride concentrations. Groundwater quality problems include high levels of boron and iron in the Napa and Sonoma Valleys and persistent nitrate concentrations in the shallow aquifer zone in the Petaluma Valley (California Department of Water Resources 2003). A 2003 study by the U.S. Geological Survey (USGS) found arsenic, boron, iron, and manganese in concentrations above drinking water standards in groundwater wells in southern Napa County (Farrar and Metzger 2003). These quality issues can affect the utility of this water, particularly for agricultural uses. Groundwater quality is discussed in more detail in Section 2.2.2.2.



Basemap: U.S. Department of Agriculture, 2001

Legend

Initial Study Area Boundary

WWTPs

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Miles

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CDM

Figure 2-1
Major Water Bodies in the North Bay Area

Although water quality problems in surface waters can affect both urban and agricultural uses, these water quality problems primarily affect environmental uses in the North Bay area. The creation of a recycled water distribution system in the North San Pablo Bay could help improve water quality in the tributary water bodies, as agricultural users move from surface water diversions to recycled water and more surface water is allowed to flow to the Bay. Environmental water quality is regulated under Federal and State law. Under Section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop a list of water quality limited segments, known as the 303(d) List. States must develop total maximum daily loads (TMDLs) for the constituents that create water quality concerns in each water body. As the name indicates, TMDLs establish limits of each constituent that can enter the waterway every day, from all potential sources. The State Water Resources Control Board (SWRCB) develops the 303(d) List for California.

Table 2-1 identifies the waterways in the North Bay region on the approved 2006 303(d) List and the regulated constituents in each waterway. These water bodies are shown on Figure 2-1. To address water quality problems in the waterways, the San Francisco Regional Water Quality Control Board (RWQCB) has imposed limitations on point sources during summer months when the waterways are most seriously impaired. Future implementation of TMDLs, or other regulatory requirements, could impose additional limitations on point sources.

Water quality impairment can affect the beneficial uses of the waterways, which are defined by the RWQCB in the San Francisco Bay Basin Plan (Basin Plan). Table 2-2 lists the major waterways and wetland areas in the study area (also shown on Figure 2-1) and the existing and potential beneficial uses assigned to them (and, for the waterways, their tributaries) in the 2007 Basin Plan. These beneficial uses highlight the broad spectrum of uses, particularly environmental uses, which are affected by degraded water quality.

2.1.3 Environmental Quality

San Pablo Bay was once bordered by more than 50,000 acres of highly-productive tidal wetlands. Those wetlands were an integral ecological complement to the open waters of the San Francisco Bay estuary, serving as a nursery grounds for fisheries, wintering areas for migratory waterbirds, and nutrient production factories for aquatic species.

Over the last century and a half, 75 percent of those wetlands were diked, drained, and disconnected from the estuary ecosystem. This process has decreased water flows and marsh habitat, including habitat for endangered or threatened species such as the California clapper rail and the salt marsh harvest mouse. The remaining marsh areas and recently restored marsh areas are providing some of these benefits, but these wetlands require a reliable water source to continue to provide value.

Table 2-1
2006 303(d) Listed Surface Water Sources

Surface Water Body	Pollutant(s)	Proposed TMDL Completion Date
Gallinas Creek	Diazinon	2005
Lagunitas Creek	Nutrients	2019
	Sedimentation/Siltation	2009
Miller Creek	Diazinon	2005
Napa River	Nutrients	2008
	Pathogens	2006
	Sedimentation/Siltation	2006
Novato Creek	Diazinon	2005
Petaluma River	Diazinon (river and tidal portion)	2005
	Nickel (tidal portion)	2019
	Nutrients (river and tidal portion)	2019
	Pathogens (river and tidal portion)	2019
	Sedimentation/Siltation (river portion)	2019
San Antonio Creek	Diazinon	2005
San Pablo Bay	Chlordane	2008
	Dichloro-diphenyl-trichloroethane (DDT)	2008
	Dieldrin	2008
	Dioxin Compounds	2019
	Exotic species	2019
	Furan Compounds	2019
	Mercury	2006
	Nickel	2019
	Polychlorinated biphenyls (PCBs)	2006
	PCBs (dioxin-like)	2019
	Selenium	2019
Sonoma Creek	Nutrients	2008
	Pathogens	2006
	Sedimentation/Siltation	2008
Walker Creek	Mercury	2006
	Nutrients	2019
	Sedimentation/Siltation	2009

Source: SWRCB 2006

Table 2-2
2007 Basin Plan Beneficial Uses

Water Body	Existing Beneficial Uses	Potential Beneficial Uses
Gallinas Creek	Cold Freshwater Habitat; Preservation of Rare and Endangered Species; Noncontact Water Recreation; Warm Freshwater Habitat; Wildlife Habitat	
Napa River	Agricultural Supply; Cold Freshwater Habitat; Fish Migration; Municipal and Domestic Supply; Navigation; Preservation of Rare and Endangered Species; Water Contact Recreation; Noncontact Water Recreation; Fish Spawning; Warm Freshwater Habitat; Wildlife Habitat	
Novato Creek	Cold Freshwater Habitat; Municipal and Domestic Supply; Preservation of Rare and Endangered Species; Water Contact Recreation; Noncontact Water Recreation; Fish Spawning; Warm Freshwater Habitat; Wildlife Habitat	Cold Freshwater Habitat; Fish Migration; Water Contact Recreation; Noncontact Water Recreation; Fish Spawning; Warm Freshwater Habitat
Petaluma River	Cold Freshwater Habitat; Estuarine Habitat; Fish Migration; Navigation; Preservation of Rare and Endangered Species; Water Contact Recreation; Noncontact Water Recreation; Fish Spawning; Warm Freshwater Habitat; Wildlife Habitat	
San Pablo Bay	Ocean, Commercial, and Sport Fishing; Estuarine Habitat; Industrial Service Supply; Fish Migration; Navigation; Preservation of Rare and Endangered Species; Water Contact Recreation; Noncontact Water Recreation; Shellfish Harvesting; Fish Spawning; Wildlife Habitat	
Sonoma Creek	Cold Freshwater Habitat; Fish Migration; Preservation of Rare and Endangered Species; Water Contact Recreation; Noncontact Water Recreation; Fish Spawning; Warm Freshwater Habitat; Wildlife Habitat	
Wetland Area	***Potential Beneficial Uses***	
Gallinas Creek	Estuarine Habitat; Preservation of Rare and Endangered Species; Water Contact Recreation; Noncontact Water Recreation; Fish Spawning; Wildlife Habitat	
Napa	Estuarine Habitat; Fish Migration; Ocean, Commercial, and Sport Fishing; Preservation of Rare and Endangered Species; Water Contact Recreation; Noncontact Water Recreation; Fish Spawning	
Novato Creek	Estuarine Habitat; Fish Migration; Preservation of Rare and Endangered Species; Water Contact Recreation; Noncontact Water Recreation; Fish Spawning	
Petaluma	Estuarine Habitat; Fish Migration; Ocean, Commercial, and Sport Fishing; Preservation of Rare and Endangered Species; Water Contact Recreation; Noncontact Water Recreation; Fish Spawning; Wildlife Habitat	
San Pablo Bay	Estuarine Habitat; Fish Migration; Ocean, Commercial, and Sport Fishing; Preservation of Rare and Endangered Species; Water Contact Recreation; Noncontact Water Recreation; Fish Spawning; Wildlife Habitat	

Source: RWQCB 2007.

Additionally, the area just north of San Pablo Bay has many small creeks and streams that provide habitat for fisheries and riparian vegetation. Many of these waterways also serve as water supplies for local farmers, which can cause a conflict between environmental use and agricultural water supply in some areas.

2.2 Demands and Supplies

Urban and agricultural land uses broadly constitute the primary water demands in the study area. Major urban land uses in the study area include residential, commercial, public land, open space (such as parks), and industrial designations. The major agricultural uses include vineyards, dairies, and pasture lands.

Groundwater is the main water supply in the area for agriculture, with small amounts of existing supply from surface water and recycled water. In most years, adequate supplies exist to meet demands on an annual basis. Supplies are strained on a seasonal basis (e.g., surface water flows are lowest in the summer when demand is highest). Future urban growth will likely exacerbate this situation, and additional sources of supply to meet future demands are limited.

2.2.1 Demands

This section discusses urban, agricultural, and environmental demands in the initial study area. Each subsection first identifies the methods to obtain these demands, and then discloses the demand for each sector.

Table 2-3
Total Water Use in the Initial Study Area

Demand Sector	*2005 (AFY)*	*2020 (AFY)*
Urban [(1)]	75,684	86,722
Agriculture [(2)]	34,428	34,000
Environmental [(3)]	NQ	NQ
Total Demand	**109,780**	**120,722**

(1) See Section 2.2.1.1, Table 2-5 for details.
(2) Represents estimated maximum agricultural water use, assumes no change in future agricultural water use.
(3) NQ = Not quantifiable. Current and future environmental demands are not quantifiable at this time.

Table 2-3 summarizes the total water demand in the initial study area[1] by demand sector in acre-feet per year (AFY). Urban demands are derived from municipal planning documents. Potential agricultural demands are derived from land use acreage data and crop specific water demand rates. Each of these demand sectors are discussed in the following subsections.

2.2.1.1 Urban Demand

The Urban Water Management Planning Act (California Water Code, Section 10610 through 10656) requires all urban water purveyors serving more than 3,000 customers or supplying more than 3,000 acre-feet (AF) annually to complete an Urban Water Management Plan (UWMP) and update it every five years. These plans identify

1 As discussed in Section 1.3, Petaluma and Marin Municipal Water District were initially evaluated in the Project, but are no longer participating.

existing and future demands and supplies for 20 years. The following section on urban demands is based on information from these plans.

2.2.1.1.1 Recent Conditions

Table 2-4 presents water use for the year 2000 for each retail water supplier within the initial study area.

Table 2-4
Urban Water Use in 2000[1]

Water Use Sectors	2000 Urban Water Use (AFY)					
	Napa[2]	Petaluma[3]	Sonoma[3]	NMWD[3]	MMWD[4]	Total
Single family residential	7,161	6,286	1,787[5]	6,345	16,002	37,581
Multi-family residential	2,017	824	N/A	1,627	3,982	8,450
Commercial	2,026	2,473	227	1,675	3,449	9,850
Industrial, Institutional and Governmental	714	721	222	370[6]	2,198	4,225
Landscape	529	N/A	156	N/A	2,613	3,298
Unaccounted-for losses	1,817	896	N/A	907	2,810[7]	6,430
Miscellaneous Accounts/Unmetered Uses[8]	908	N/A	N/A	N/A	N/A	908
Raw Water Irrigation[9]	198	N/A	N/A	250	N/A	448
Total	15,370	11,200	2,392	11,174	31,054	**71,190**

(1) Each agency uses slightly varying accounting measures for total water use, as indicated in following footnotes.
(2) City of Napa 2006
(3) SCWA 2001a; NMWD = North Marin Water District
(4) MMWD = Marin Municipal Water District; MMWD 2003
(5) City of Sonoma combines single family and multi-family residential uses
(6) Includes Landscape uses
(7) Includes adjustments to water use
(8) Includes special accounts such as hydrants and the Napa State Hospital and unmetered uses such as main flushing, large main breaks, and water treatment plant de-sludging
(9) Raw water irrigation includes service to Indian Valley Golf Course and the County of Marin's Stafford Lake Park and interruptible service to customers outside of Napa city limits

N/A – Not available – Agency/Contractor did not define specific sector in water use calculations

The Sonoma County Water Agency (SCWA) is a wholesale water supplier. SCWA contracts with the following cities and municipal agencies to purchase water and deliver it to residential, commercial, and industrial customers: City of Petaluma; City of Sonoma; North Marin Water District (NMWD), serving Novato; Marin Municipal Water District (MMWD), serving San Rafael, Corte Madera, Tiburon, Sausalito, and smaller area communities; and Valley of the Moon Water District (VOMWD), serving the unincorporated Sonoma County communities of Fetter Hot Springs, Agua Caliente, Boyes Hot Springs, El Verano, Trinity Oaks, Glen Ellen, and Temelec.

2.2.1.1.2 Future Conditions

In their UWMPs, local water agencies project future water use. Changes in urban water demand are primarily driven by changes in population. Table 2-5 presents a summary of the initial study area's year 2005 use and projected water demands through 2020. The total projected urban water use in 2020 for the initial study area is

86,722 AF, which is about a 15 percent increase over year 2005 water use of 75,684 AF. The water use includes both residential and non-residential customers.

Table 2-5
Historic and Projected Urban Water Use Summary

Agency/Contractor	Total Urban Water Use (AFY)			
	2005	**2010**	**2015**	**2020**
Napa[1]	15,370	16,395	17,489	18,798
Petaluma[2]	11,996	12,798	13,361	13,958
Sonoma[2]	2,714	2,991	3,269	3,544
NMWD Service Area[2]	13,294	14,186	15,022	15,022
MMWD Service Area[3]	32,310	33,690	34,690	35,400
Total	**75,684**	**80,060**	**83,831**	**86,722**

(1) City of Napa 2006
(2) SCWA 2001a
(3) MMWD 2003

2.2.1.2 Agriculture/Irrigated Demand

Calculated agricultural demands within the study area did not exist prior to this study. Therefore, the participating agencies calculated existing demands based on land use patterns and crop water needs. The California Department of Water Resources (DWR) provided land use data for Marin County, Napa Sanitation District (Napa SD) and DWR provided information for Napa County, and SCWA provided data for Sonoma County (DWR 1999a and 1999b; Napa SD 2005; SCWA 2001b). Land use maps indicate that agricultural and urban landscaping acreage within the recycled water project areas considered in this study (see Section 5) totals about 40,500 acres. Out of this acreage, less than 1 percent is non-irrigated farmland (idle and dry farming lands).

Table 2-6 presents the acreage of each type of irrigated land described in the subsections below and the associated estimated water use rate in acre-feet per acre (AF/acre). Based on this data, a total maximum estimated water use is developed for agricultural lands considered for recycled water use in the initial study area.

Table 2-6
Irrigated Acreage and Water Use in the Initial Study Area

Land Use Type	Water Use Rate (AF/acre)	Acres	Total Maximum Water Use (AFY)
Urban Landscaping			
Marin County	2.234	1,335	2,982
Napa County	2.801	644	1,804
Sonoma County	3.250	333	1,083
Total		*2,312*	*5,868*
Dairy & Pasture			
Marin County	2.502	0	0
Napa County		37	92
Sonoma County		4,721	11,811
Total		*4,757*	*11,903*
Orchard			
Marin County	2.971	0	0
Napa County		30	90
Sonoma County		0	0
Total		*30*	*90*
Irrigated Farm			
Marin County	1.339	0	0
Napa County		0	0
Sonoma County		2,924	3,915
Total		*2,924*	*3,915*
Vineyard			
Marin County	N/A	0	0
Napa County	0.250	10,289	2,572
Sonoma County	0.500	20,156	10,078
Total		*30,445*	*12,650*
Totals		**40,469**	**34,428**

N/A = Not applicable
Note: The Petaluma and MMWD service areas are included in this water use estimate.

It is worth noting that more than 75 percent of the land considered for recycled water use consists of vineyards. That area accounts for 37 percent of the water demand. Dairy/pasture land has the next highest water demand with 35 percent of the total water use.

2.2.1.2.1 Recent Conditions

As there are no records *per se* on agricultural water demand, it is necessary to estimate agricultural water use by a balance of theoretical and observed information. The development of agricultural water demand totals drew upon theoretical demand information (measured as evapotranspiration of applied water (ETAW)) from the California Irrigation Management Information System (CIMIS), crop coefficients from the University of California (UC) at Davis, records of actual water use obtained from the City of Santa Rosa's subregional wastewater treatment plant (WWTP), and local information obtained from each member agency of the Authority.[2]

This section summarizes demand calculations for each irrigated land use. Estimated total water use for irrigation in the study area is about 34,400 AFY, with the major demand exerted by vineyards (37 percent) and dairies/pastureland (35 percent).

Urban Landscaping

Average theoretical total applied water (TAW) values from the Santa Rosa CIMIS station predicted that urban landscaping water use would be about 3.56 AF/acre annually, and that peak average monthly water use would occur in July at 0.61 AF/acre. Customers in Santa Rosa using recycled water for urban landscaping include individual businesses, business parks, and housing developments. Between 1998 and 2003, actual recycled water use for urban landscaping ranged from 1.62 AF/acre in 1998 to 2.81 AF/acre in 2001 with an average use of 2.23 AF/acre. This average actual use is about 1.33 AF/acre less than the theoretical water demand. Peak average monthly water use typically occurred in August (0.45 AF/acre), and little or no water use occurred during the months of December through March. In general, less water is applied throughout the year for this land use than would be expected.

After reviewing the actual and theoretical urban landscaping water demand values, additional information was obtained from SCWA and Napa SD. These agencies developed estimated water demands specific to their own service areas and microclimates. This study will use those rates for consistency with existing plans developed by the participating agencies.

Table 2-7 presents the urban landscaping demands used in this study. The SCWA values are the average of their landscaping water demand (3 AF/acre) and golf course water demand (3.5 AF/acre).

[2] Water use of crops is measured as ETAW. This factor measures the amount of total applied (or irrigated) water (TAW) used by the plant for evaporation or transpiration. For each crop, water use per acre varies based on location and irrigation practices.

Theoretical demand information is available from CIMIS for a reference crop, typically grass. Crop coefficients, available from UC Davis, can translate the demand for a reference crop into demand for a specific crop. These factors derive a theoretical demand, but this information does not always reflect local practices. Theoretical demand results were compared to actual water use obtained from the City of Santa Rosa's subregional WWTP. The Santa Rosa subregional WWTP is one of the few facilities in the North Bay region that meters the use of recycled water by each of its customers. Santa Rosa currently has over 10 years of metered recycled water use data.

Each member agency obtained local information to reconcile the differences between theoretical and actual demand in their service area for agriculture.

Table 2-7
Urban Landscaping Water Demand

Month	Marin County (1) (AF/acre)	Napa County (2) (AF/acre)	Sonoma County (3) (AF/acre)
Jan	0.002	0.000	0.000
Feb	0.002	0.000	0.000
Mar	0.018	0.000	0.000
Apr	0.157	0.243	0.281
May	0.195	0.398	0.461
Jun	0.376	0.533	0.618
Jul	0.439	0.573	0.664
Aug	0.452	0.509	0.591
Sep	0.309	0.369	0.428
Oct	0.242	0.178	0.206
Nov	0.030	0.000	0.000
Dec	0.012	0.000	0.000
Total	**2.234**	**2.801**	**3.250**

Source:
(1) Santa Rosa WWTP actual recycled water use.
(2) Napa SD 2005
(3) SCWA 2005

Pasture

Pasture land irrigated with recycled water from the Santa Rose WWTP used an average 1.84 AF/acre. Peak average water use typically occurred in July at 0.38 AF/acre. Between November and March, water use was negligible. Theoretical water demand for pasture was estimated to be 3.56 AF/acre, about 94 percent greater than actual water demand from the Santa Rosa WWTP. The actual water demand values show that less water was applied than expected between February and November with the difference decreasing after May. During January and December, more water was applied than expected.

Table 2-8
Dairy and Pasture Water Demand

Month	Study Area (AF/acre)
January	0.000
February	0.000
March	0.000
April	0.217
May	0.355
June	0.476
July	0.511
August	0.455
September	0.330
October	0.158
November	0.000
December	0.000
Total	**2.502**

Sources: Napa SD 2005, SCWA 2005

The SCWA and Napa SD studies both estimated pasture water demand to be about 2.5 AF/acre. The study will use this water demand value for all three counties in order to be consistent with existing plans developed by the participating agencies. Table 2-8 presents the monthly demand curve for dairy and pasture water demand.

Irrigated Farm

Irrigated farm property includes rice and field, truck, nursery, and berry crops. The water demand for these crops, presented in Table 2-9, was developed from Santa Rosa WWTP customer data and applied to all three counties where irrigated farmland exists.

Table 2-9
Irrigated Farmland Water Demand

Month	Actual Water Use (AF/acre)
January	0.008
February	0.001
March	0.021
April	0.063
May	0.135
June	0.222
July	0.281
August	0.305
September	0.208
October	0.086
November	0.009
December	0.001
Total	**1.339**

Orchard

Water demand for orchards was estimated using TAW data from the Petaluma East CIMIS station, in combination with theoretical crop coefficients for orchards without crop cover[3]. Actual data for this crop category was not available from the participating agencies. The data presented in Table 2-10 is average water use for deciduous peach, apricot, pear, plum, almond, and pecan orchards, and apple and cherry orchards, without crop cover. This water demand for orchards was applied to all three counties where orchards exist.

Table 2-10
Orchard Water Demand

Month	Theoretical Water Demand (AF/acre)
January	0.000
February	0.017
March	0.174
April	0.315
May	0.497
June	0.602
July	0.514
August	0.401
September	0.289
October	0.144
November	0.018
December	0.000
Total	**2.971**

Vineyards

Figure 2-2 presents the calculated TAW for vineyards and compares it to the demand pattern for vineyards using recycled water in Santa Rosa. In Santa Rosa, actual water use was much less than the calculated TAW. Regional irrigation specialists from the UC Davis Cooperative Extension indicate that regional vineyard operators widely practice Regulated Deficit Irrigation (RDI) (Smith 2003; Pritchard 2003). RDI is an agricultural practice in the wine industry that strategically decreases the quantity of applied water during periods of the growing season. This practice causes the plant to be slightly stressed during these periods and enhances characteristics such as berry size and color. Regional RDI practices reduce the actual evapotranspiration value to approximately 60 percent of the theoretical evapotranspiration value reported by CIMIS (Pritchard 2003). Decreased irrigation causes the plant to use more of the soil moisture, which also allows for more storage of rainfall in the soil. Vineyard water demand adjusted for RDI practices reduced the average yearly water use to 0.52 AF/acre.

[3] Crop cover is low-lying vegetation or crops planted to cover the bare ground. It is often used to improve soil conditions and decrease weeds and pests in the orchard.

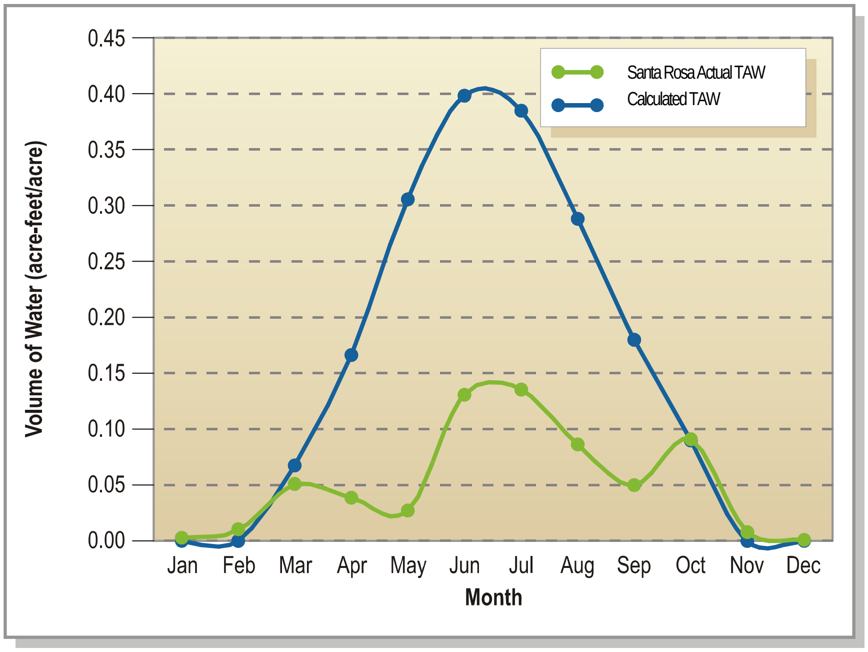


Figure 2-2
Calculated and Actual TAW Vineyard Demands

After reviewing these actual and theoretical vineyard water demands, additional information was obtained from SCWA and Napa SD. In their recycled water plans, both agencies developed estimated vineyard water use rates specific to their service areas. The study used these rates for consistency with the existing plans developed by the participating agencies. The rates are presented in Table 2-11. A vineyard water demand was not developed for Marin County because no vineyard land use was identified in the Marin County portion of the study area.

Table 2-11 Vineyard Water Demand		
Month	***Napa County (1) (AF/acre)***	***Sonoma County (2) (AF/acre)***
Jan	0.000	0.000
Feb	0.000	0.000
Mar	0.000	0.000
Apr	0.000	0.000
May	0.000	0.104
Jun	0.088	0.153
Jul	0.086	0.145
Aug	0.053	0.084
Sep	0.023	0.014
Oct	0.000	0.000
Nov	0.000	0.000
Dec	0.000	0.000
Total	**0.250**	**0.500**

Source:
(1) Napa SD 2005
(2) SCWA 2005

2.2.1.2.2 Future Conditions

Agricultural water use within the study area is anticipated to change in the future and be dependent on factors that influence the crop composition within the region. The two major factors that could change agricultural land use include urbanization and economic pressure to shift to different crops. Due to the uncertainty associated with these factors, calculating rigorous future agricultural water use is not currently possible.

Growing populations within the study area could cause urban areas to expand in the future. Sonoma, Marin, and Napa Counties have objectives and policies within their General Plans to protect conversion of agricultural land to non-agricultural uses. These objectives and policies try to focus urban development on infill, with only small extensions to urban boundaries. Based on land use data from DWR, Napa SD, and SCWA, there are about 375 acres of vineyard and about 170 acres of urban landscaping planted within urban growth boundaries in the study area (DWR 1999a and 1999b; Napa SD 2005; SCWA 2001b). That suggests that agricultural water use in the study area could decline by about 610 AFY (using averaged water use rates for each land use category) if those agricultural areas were converted to urban uses. Land use is discussed in detail in Section 3.

Crop prices and productivity are highly sensitive to weather conditions, the world market, and local and national economic conditions. These factors make forecasting changes very difficult. The Sonoma County Agricultural Commission indicates that conversions from hay to vineyards do not appear to be a continuing trend (Ramey 2003). Therefore, the effect of these factors would not likely have a large effect on future agricultural water use. Section 3.2 further discusses potential agricultural development in the study area.

Grape growers in the study area will most likely continue to irrigate their vineyards using the drip irrigation method and employ deficit irrigation practices, which is a growing management trend.

2.2.1.3 Environmental Demand

2.2.1.3.1 Recent Conditions

Environmental water demands include water for plant and animal uses throughout the watershed. Calculating environmental demands and projecting future demands requires knowledge of habitats, demands by habitat type, in-stream flow requirements, and groundwater-surface water interactions for areas with shallow groundwater. Some of this information is not yet available; therefore, rigorous demand calculations are not currently possible. These issues will be studied as a part of the Project’s environmental documentation.

Environmental water uses within the region benefit multiple habitats: in-stream aquatic habitat, riparian vegetation, lake and reservoir aquatic habitat, and wetlands. Predominant riparian habitat in the study area includes maples, oaks, alders, willows, California wild grape, blackberry, poison oak, mugwort, and California rose (North

Bay Watershed Association [NBWA] 2003). Special status species are further discussed in Section 3.3.1.

Creeks and rivers within the region provide in-stream habitat for fish. Salmonid populations, including special status spring-run Chinook salmon and steelhead, inhabit the Petaluma River and its tributaries, Sonoma Creek and its tributaries, Corte Madera Creek, Arroyo Corte Madera, and several other creeks within the eastern Marin County watersheds (NBWA 2003). The watersheds support other fish species, including trout, sticklebacks, sculpin, suckers, shad, sunfish, and lampreys. U.S. Fish and Wildlife Service and Sonoma County have also found California freshwater shrimp, a special status species, in multiple locations in Sonoma Creek (NBWA 2003).

California Department of Fish and Game (CDFG) and National Marine Fisheries Service (NMFS) developed "2002 Guidelines for Maintaining In-Stream Flows to Protect Fisheries Resources Downstream of Water Diversions in Mid-California Coastal Streams (Guidelines)" to protect anadromous salmonids and habitat in mid-California streams (CDFG and NMFS 2002). The guidelines support environmental water uses by proposing limits on the maximum cumulative water that can be diverted in a watershed.

2.2.1.3.2 Future Conditions

Factors potentially affecting future environmental water uses include land use changes, government regulations, and increased environmental restoration and enhancement activities.

Land use changes, including urban development, could affect the amount and quality of terrestrial and aquatic habitats. Increased regulations and restoration activities could improve habitat and potentially increase environmental water uses. CDFG and NMFS Guidelines recommend flows in creeks and streams within the region to protect anadromous fisheries. CDFG and NMFS monitor in-stream habitat and will revise guidelines as necessary in the future to continue protection of fisheries resources.

Watershed restoration projects, such as increased fish passage programs and sediment removal projects, could increase base flows in streams. Wetland enhancement programs would also require additional water to support managed wetlands.

The Napa River Salt Marsh Restoration Project consists of the restoration of tidal wetlands and enhancement of managed ponds in the Napa Sonoma Marsh Wildlife Area. The project is sponsored by the California Coastal Conservancy, U.S. Army Corps of Engineers, and the CDFG. The approximately 9,500-acre Napa River Unit consists of 12 former salt evaporation ponds located on the west side of the lower Napa River. The project aims to create a mix of tidal habitat and managed pond habitat that services a broad range of wildlife, restore large areas of tidal habitats in a band along the Napa River ensuring connections between the patches of tidal marsh, and improve the ability to manage water depths and salinity levels in the managed ponds to maximize feeding and resting habitat for migratory and resident waterfowl.

A water source is needed for habitat and flushing operations because annual evaporative water loss from the salt ponds substantially exceeds the water replaced by precipitation. Water intake and discharge of pond water through flow-through circulation is desired to prevent the salt ponds from becoming increasingly saline and only seasonally wet salt or bittern flats. Two water sources have been evaluated for habitat and flushing operations: Napa River diversions brought about by planned levee breaches, and construction of a recycled water pipeline from the Sonoma Valley County Sanitation District (SVCSD) WWTP and/or Napa SD WWTP. The use of recycled water for this restoration project continues to be evaluated. The recycled water delivery option calls for 8,000 to 9,000 AFY of recycled water for salinity reduction (flushing) and water level maintenance during the first six to eight years of the project (U.S. Army Corps of Engineers 2004). It is possible that an additional 2,500 to 3,000 AF of recycled water may be required for pond maintenance, to offset evaporation in the upper ponds, once flushing is complete.

2.2.2 Supplies

The study area receives water from sources both inside and outside the region. Water sources within the region include the Napa River, Petaluma River and Sonoma Creek (used for agricultural supplies), and Stafford Lake on Novato Creek. Surface water sources outside the region include the Russian River Project (including Lake Mendocino, Lake Sonoma, and imports from the Eel River via Pacific Gas & Electric Company's Potter Valley Project), Lake Hennessey, Milliken Reservoir, MMWD's six Lagunitas Creek watershed reservoirs, Soulajule Reservoir, and the Sacramento-San Joaquin Delta via the State Water Project (SWP). The region also relies on groundwater and recycled water as additional sources. Recent and future water supplies from these sources are described below. Table 2-12 summarizes the total water supply in the initial study area[4] by source.

Table 2-12
Total Water Supplies in the Study Area

Supply Source	***2005 (AFY)***	***2020 (AFY)***
Surface Water (1)	139,277	138,617
Groundwater (2)	10,167	1,234
Recycled Water (3)	9,667	15,075
Total Supply	159,111	154,926

(1) Surface water supply data represents the reliable (dry year) supply. Current supplies for the Petaluma River watershed are not quantifiable at this time. See Section 2.2.2.1, Table 2-13 for derivation.
(2) See Section 2.2.2.2, Table 2-15 for derivation. Values do not include agricultural pumping in Petaluma and Sonoma Valleys, which has not been quantified.
(3) See Section 2.2.2.3, Table 2-17 for derivation.

[4] As discussed in Section 1.3, Petaluma and MMWD were initially evaluated in the Project, but are no longer participating.

2.2.2.1 Surface Water

The main surface water bodies included in the initial study are San Pablo Bay, Novato Creek in Marin County, Petaluma River and Sonoma Creek in Sonoma County, and Napa River in Napa County. The locations of these water bodies are presented in Figure 2-1. Table 2-13 summarizes the reliable (dry year) supply from these surface sources. Smaller tributaries and sloughs also exist, such as Huichica Creek, Suscol Creek, Hudeman Slough, and Schell Slough.

Table 2-13
Reliable Surface Water Supplies in the Initial Study Area

Watershed	***2005 (AFY)***	***2020 (AFY)***
Russian River and Dry Creek (1)	87,970	84,970
Petaluma River and Sonoma Creek (2)	NQ	NQ
Lagunitas Creek and Walker Creek (3)	20,785	20,785
Stafford Lake (4)	1,982	1,982
Napa River Watershed (5)	23,000	23,000
SWP (5)	5,540	7,880
Total Reliable Supply (low estimate2)	139,277	138,617

(1) Source: SCWA 2001a
(2) NQ = Not quantifiable. Current supplies for the Petaluma River watershed are not quantifiable at this time.
(3) Source: Roxon 2005
(4) Source: NMWD 2002
(5) Source: City of Napa 2006, Jones & Stokes 2003

Surface water runoff creates the majority of freshwater flows within the rivers and streams. Consequently, streamflow in all of the creeks and rivers varies greatly by season and year depending on precipitation. Many smaller tributaries are naturally dry during the summer, while in others flows vary between wet and dry years. The withdrawal of water from streams for both agricultural and domestic uses has affected flow rates in the streams. Lower base flow rates occur in the streams as a result of water being held in reservoirs and directly withdrawn from the streams and aquifers. Bordering the study area is San Pablo Bay, the depth of which is highly dependent on inflow from its tributaries, including the Napa River, Sonoma Creek, and Petaluma River.

Table 2-14 presents the monthly mean streamflows in cubic feet per second (cfs) for Sonoma Creek, Napa River, Petaluma River, and Novato Creek. During the wet season, flows in these surface waters range from about 48 cfs (Novato Creek) to 257 cfs (Sonoma Creek), but each source's low mean flow is less than 1 cfs, occurring during the summer irrigation season.

Table 2-14
Maximum and Minimum Monthly Mean Stream Flows

Source	High Mean Flow Month	High Mean Flow (cfs)	Low Mean Flow Month	Low Mean Flow (cfs)	Measurement Time Period
Sonoma Creek (at Agua Caliente)	January	257	September	0.78	1955-2002
Napa River (at Napa)	January	63.4	September	0.89	1970-1983
Petaluma River (at Petaluma)	February	64.2	July	0	1948-1963
Novato Creek (at Novato)	February	47.7	September	0.3 (1)	1946-2002

Source: USGS 2003
(1) Regulated flow released from Stafford Lake for fisheries.

Individual agricultural growers collect surface water in Napa and Sonoma Valleys via on-site ponds and reservoirs or other surface water diversion facilities. Agricultural water users in the baylands use water from on-site reservoirs. Some growers have applied for water rights to divert surface water, but typically this process has taken several years (Fry 2003).

2.2.2.1.1 Russian River and Dry Creek

SCWA provides water from the Russian River and its tributaries in central Sonoma County to NMWD, MMWD, VOMWD, and the Cities of Sonoma and Petaluma. SCWA's transmission system includes the pipelines, tanks, and pumps that deliver water from its Russian River diversion facilities to the Santa Rosa, Petaluma, and Sonoma Valleys. Major SCWA pipelines include the Santa Rosa Aqueduct, the Sonoma Aqueduct, the Petaluma Aqueduct, and the Russian River to Cotati Intertie. NMWD has its own aqueduct to take SCWA water from the Petaluma Aqueduct into Novato.

The total reliable surface water supply available for SCWA and its customers is 212,920 AF during an average year and 87,970 AF during a dry year (SCWA 2001a). SCWA's November 2004 staff report indicated that SCWA would be unable to meet seven-day peak demands because of capacity limitations of its transmission system. Prolonged peak demand periods would significantly reduce water levels in storage tanks in Sonoma and southern Petaluma (SCWA 2004).

2.2.2.1.2 Petaluma River and Sonoma Creek Watersheds

Petaluma River and Sonoma Creek provide water for agricultural uses, not for urban uses. Agricultural users in these areas do not use any Russian River supplies for irrigation purposes. A network of tributaries supplies water for agricultural uses in both watersheds. Many users divert water during winter or spring months and store it in local ponds for use during the summer irrigation season.

The Petaluma River watershed comprises about 146 square miles. The headwaters of the Petaluma River begin upstream of the city on Sonoma Mountain and multiple creeks join the river as it flows to the valley portion of the watershed. The lower 12 miles of the Petaluma River flow through Petaluma Marsh and drain into San Pablo

Bay. The U.S. Army Corps of Engineers dredges the river on a continual basis because of high siltation rates. With insufficient fresh water to flush the river during the summer months, temperature and salinity increase and reduce the ability of the water to hold oxygen (Southern Sonoma County Resource Conservation District [RCD] 1999). Inadequate dissolved oxygen not only contributes to an unfavorable environment for fish and other aquatic life, but can also result in objectionable odors from anaerobic decomposition (Southern Sonoma County RCD 1999).

The Sonoma Creek watershed is 170 square miles. Sonoma Creek begins on Sugarloaf Ridge and flows 31 miles to North San Pablo Bay. The creek has multiple tributaries. Sonoma Creek is the principal drainage for the Sonoma Valley sub-basin. The southern Napa and Sonoma Valley basins receive an average of 20 to 24 inches of precipitation a year and the highest runoff occurs shortly after rainfall. Levels of precipitation and soil permeability affect the volume of creek and river flow into the Bay (Jones and Stokes 2003).

2.2.2.1.3 Lagunitas Creek and Walker Creek Watersheds

MMWD collects runoff from approximately 50,000 acres in Marin County, and has seven storage reservoirs in the Lagunitas Creek and Walker Creek watersheds to store and provide surface water to users. Reliable supply from these sources is approximately 20,785 AFY (Roxon 2005).

2.2.2.1.4 Stafford Lake Watershed

Stafford Lake, owned and operated by NMWD, lies approximately five miles west of the study area in northern Marin County and receives runoff from the watershed land adjacent to the upper reaches of Novato Creek (NMWD 2002). The lake provides about 20 percent of the total water supply to the area of Novato. The watershed supplied approximately 1,982 AF of water to Novato in 2000.

2.2.2.1.5 Napa River Watershed

Napa receives water from Lake Hennessey and Milliken Reservoir in the Napa River watershed. Reliable supply from these two facilities is approximately 11,117 AFY (City of Napa 2006). The long-term average discharge of the Napa River is approximately 66,000 AFY. Diversions from the Napa River for agricultural use in the County are 12,000 AFY (Jones & Stokes 2003). Although surface water flows vary according to precipitation, discharges from groundwater increase the surface water flow of the Napa River during dry years.

2.2.2.1.6 SWP

Napa also receives water from the Sacramento-San Joaquin Delta through the North Bay Aqueduct (NBA). Napa could receive up to 18,800 AF from the SWP in 2021, but this quantity would typically only be available during wet years. The reliable supply for 2005 was estimated to be 5,540 AFY (City of Napa 2006). The SWP is currently only available to municipal and industrial users in the Napa County service area.

2.2.2.2 Groundwater

Agricultural users within the southern Sonoma, Petaluma, and Napa Valleys use groundwater as a water supply. Groundwater is also a supply for urban demands in the Sonoma and Petaluma Valleys. Groundwater supplies are summarized below in Table 2-15.

Table 2-15
Total Groundwater Supplies in the Initial Study Area

	2005 (AFY)	2020 (AFY)
City of Petaluma	3,585 (1)	0 (1)
City of Sonoma	448 (1)	450 (1)
VOMWD	784 (1)	784 (1)
Napa County – MST area (2)	5,350 (2)	N/A
Total (3)	10,167	1,234

(1) Source: Booker 2006, SCWA 2001a
(2) Values for Milliken-Sarco-Tulocay Creeks (MST) area are for agricultural and private drinking water pumping for 2000. Source: USGS 2003.
(3) Total does not include agricultural pumping in Petaluma and Sonoma Valleys, which has not been quantified.

2.2.2.2.1 Groundwater Conditions

In the North Bay, the principle groundwater-bearing aquifer comprises alluvial deposits, which cover most of the valley areas in Sonoma, Napa, and Petaluma Valleys. These aquifers are largely continuous, with general flow towards San Pablo Bay. However, in the region adjacent to the Bay, local flow has been reversed. Groundwater levels in the alluvial deposits vary locally, but are generally between 5 and 75 feet below the ground surface. In southern Sonoma County, local variations are observed due to the presence of local impermeable layers, which create small semi-confined aquifers. Specific yield is a measure of aquifer productivity, and is defined as the ratio of the volume of water in a particular sample to the total volume of the sample. In alluvial deposits, the specific yield is moderate to high (8 to 17 percent), which illustrates that the aquifer can produce substantial amounts of water.

Some of the natural recharge into alluvial aquifers occurs from rivers and streams. In southern Napa County, local groundwater recharge originates from precipitation falling within the Milliken-Sarco-Tulocay Creeks (MST) drainage basins as well as alluvial deposits and volcanic rocks (USGS 2003). Generally, the alluvial deposits are not permeable enough to allow natural recharge from surface infiltration, although there is some limited recharge through surface infiltration due to precipitation. A layer of Bay mud, containing brackish water, covers the alluvial deposits in most areas. Groundwater pumping from some of these deposits has an adverse effect of drawing brackish water into the freshwater alluvial deposits, causing saltwater intrusion (DWR 1982a and 1982b).

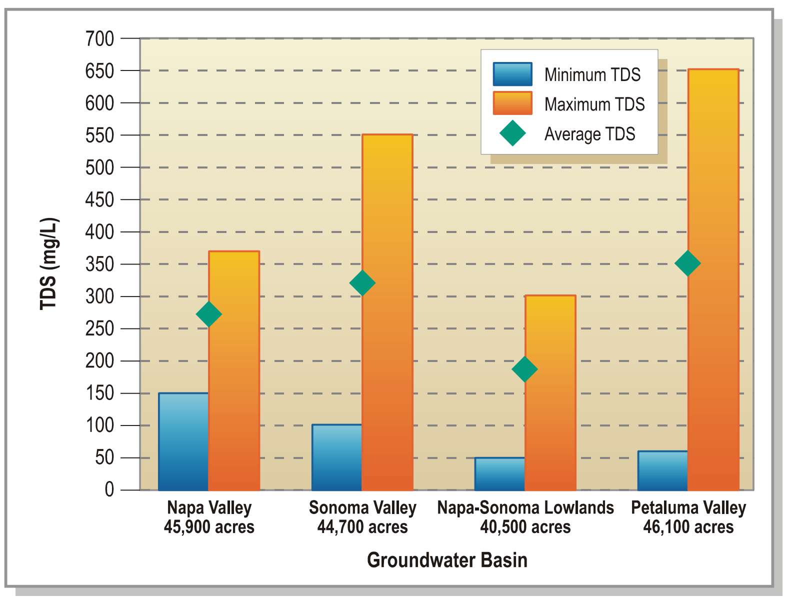
As the land elevation ascends into the Huichica mountain range, the groundwater aquifer changes conditions due to previous volcanic deposits. The Huichica formation is composed of reworked volcanic sediments, with a low specific yield ranging from 3 to 7 percent. The low specific yield illustrates that this aquifer has lower productivity than alluvial deposits. The Huichica formation produces limited amounts of groundwater, and the same soil conditions that limit productivity also limit recharge. The primary source of recharge is through infiltration, usually through outcrops of the formation in the higher mountainous areas.

A 2003 USGS study of the MST basins found that groundwater outflow in 2000 exceeded inflow by about 600 AFY. The drainage basin area sustained a population of about 16,500 in 2000, and 4,800 of those people relied solely on their own groundwater wells. In 2000, groundwater pumping (for drinking water, open-space irrigation, and agriculture) was estimated to range between 5,350 AFY and 7,100 AFY, an increase of at least 80 percent over 1975 pumping rates (Farrar and Metzger 2003).

Increased groundwater pumping has significantly changed the hydraulic gradient in the groundwater basin. Before 1975, groundwater flowed west from the mountains surrounding the MST area towards the Napa River. Now, three groundwater level depressions have formed the central and eastern part of the basin. The two deepest depressions show groundwater levels 50 to 125 feet lower in 2000 than in 1975. The third depression's water levels declined 25 to 50 feet over the same time period. The study concludes that an additional water supply in the area is needed to stop the groundwater level decreases (Farrar and Metzger 2003).

2.2.2.2.2 Groundwater Quality

Figure 2-3 shows the summary of total dissolved solids (TDS) data from 1994 to 2000 for 485 public supply wells from the California Department of Public Health (DPH) water quality database. According to DPH, the recommended limit for TDS in domestic water is 500 milligrams per liter (mg/L) (DWR 1982a and 1982b). The maximum limit for TDS is 1,000 mg/L. Water with a TDS level higher than 500 mg/L may also be expected to contain other hazardous ions, which are usually high in sodium and salinity. The average TDS levels show that groundwater quality is good



Source: DWR 2003

Figure 2-3
Groundwater Quality of Public Supply Wells, 1994-2000

according to the wells measured in Napa, Sonoma, Novato, and Petaluma Valleys (DWR 2003).

The 2003 USGS study found that groundwater in the study area is of an acceptable quality. Table 2-16 summarizes the groundwater quality sampling performed at 15 private wells in the MST basin. The study concluded that volcanic minerals or older and deeper rocks were likely responsible for the arsenic, boron, iron, and manganese found in the groundwater samples (Farrar and Metzger 2003).

Table 2-16
Groundwater Quality Results for Milliken-Sarco-Tulocay Creeks Basin

Constituent	*Drinking Water Quality Standard*	*Number of Private Wells With Results Above the Standard* [1]
Arsenic [2]	10 micrograms (μg)/L	5
Boron	1 mg/L	2
Iron	300 μg/L[3]	5
Manganese	50 μg/L[3]	12
TDS [4]	500 mg/L	1

(1) Source: Farrar and Metzger 2003
(2) Sample results ranged from 2-67 μg/L. Three wells had concentrations greater than 15 μg/L.
(3) Secondary drinking water standard.
(4) Sample results ranged from 144-732 mg/L.

2.2.2.2.3 Supplies

The total quantity of groundwater supply available in the study area is unknown. Because this resource is underground, understanding the extent of this water supply would require extensive testing and would still only reflect estimated quantity. The only places where groundwater supplies are quantifiable are where they are limited by infrastructure development, such as urban areas with several wells.

Napa County's groundwater conservation ordinance, Ordinance 1162, prohibits groundwater extraction for wasteful and non-beneficial purposes. Agricultural developments in the groundwater–depleted MST area require a groundwater permit, unless specifically exempt. Permits issued for the MST area require that wells have meters installed and limit the user to 0.30 AFY, calculated as a three-year average. Groundwater wells serving agricultural areas outside the MST area do not require permitting. The county issues groundwater permits to single-family homes (with associated landscaping) with requirements for submittal of well meter readings twice yearly and use limited to 0.60 AFY (13 Napa County Code).

USGS has estimated that groundwater pumping in southeastern Napa County in 2000 was 5,350 AFY, an increase of approximately 80 percent since 1975. This increase in extraction has resulted in the general decline of groundwater levels and possibly changes in infiltration capacity caused by land use changes (USGS 2003). Low rainfall, saltwater intrusion from San Pablo Bay, and low soil permeability aggravate the groundwater supply problem in the region. Although the clay content holds water in the soil, it restricts water percolation to the water table and effectively decreases the volume of groundwater available for irrigation. Most growers apply short, frequent irrigations to not exceed the infiltration rate of the soil. The irrigation season lasts from June to late September or early October (Carneros Wine Alliance 2003).

The Cities of Petaluma and Sonoma and VOMWD use groundwater to supplement SCWA surface water supplies. In addition, SCWA has three wells in the Santa Rosa Plain and seven in the lower Russian River that augment its Russian River water supplies.

Petaluma has 11 operational wells with a long-term reliable supply of 3,585 AFY. In 2000, groundwater provided approximately 9 percent of Petaluma's water supply. Sonoma has three groundwater wells with a long-term reliable supply of 448 AFY. VOMWD has three wells with a long-term supply of 784 AFY. Groundwater provided less than 1 percent of Sonoma's water supply and 27 percent of VOMWD supply in 2000 (Booker 2006, SCWA 2001a).

Groundwater use in the MMWD and NMWD service area is limited because they do not have substantial underlying groundwater aquifers. Groundwater use in the MMWD and NMWD service areas is also constrained by availability and quality. The City of Napa does not use groundwater for drinking water supplies.

2.2.2.3 Recycled Water

Table 2-17 summarizes the recent and planned recycled water production in the initial study area in the absence of this project. Las Gallinas Valley Sanitary District (LGVSD), Novato Sanitary District (Novato SD), the City of Petaluma, SVCSD, and Napa SD currently serve recycled water to agricultural and landscaping customers. The quantities included in this table reflect the amount of recycled water produced for customers (beneficial reuse) and agency spray irrigation.

Table 2-17
Recent and Planned Recycled Water Production in the Initial Study Area

Agency	***AFY***			
	2005	***2010***	***2015***	***2020***
LGVSD[1]	615	902	902	902
Novato SD[2]	2,213	2,710	2,760	2,810
City of Petaluma[3]	2,389	3,823	3,823	3,823
SVCSD[4]	1,200	2,000	2,500	3,000
Napa SD[5]	3,250	3,680	4,110	4,540
Total	9,667	13,115	14,095	15,075

Sources:
(1) MMWD 2003
(2) James 2008
(3) City of Petaluma 2004
(4) Booker 2006
(5) Based on preferred alternative in Napa SD's *Strategic Plan for Recycled water Use in the Year 2020* (Napa SD 2005).

The LGVSD Water Recycling Plant (in conjunction with MMWD) serves 275 customers. The recycled water is predominantly used for landscape irrigation, but also for toilet flushing at the county jail and nearby office buildings, and one car wash. Although 902 AFY is entitled to existing MMWD customers to offset potable demands, actual annual usage varies with the seasonal weather. In 2005, the recycling plant supplied about 615 AFY of recycled water for beneficial uses, though the users often meet or exceed their total entitlement in other years. Information on the LGVSD treatment plant, capacity, and operations is included in Section 4.2.1.

In 2005, the Novato SD WWTP provided about 2,213 AFY of recycled water for wildlife habitat and agricultural uses from May to October (James 2006). Because recycled water from Novato SD was not applied for any urban uses, it did not offset any potable demands. In 2008 Novato SD began operations of a recycled water facility, located east of its WWTP. The facility has a capacity of 0.5 million gallons per day (mgd), and is expandable to 1.0 mgd. The plant will provide 269 AFY to the local Stone Tree Golf Course as a potable water offset. Information on the Novato SD WWTP, capacity, and operations is included in Section 4.2.2.

The City of Petaluma uses recycled water for irrigation of crops and golf courses. In 2004, the city provided about 730 AFY of disinfected secondary effluent to the Rooster Run Golf Course, the Adobe Creek Golf Course, and a small vineyard (City of Petaluma 2004). Additional recycled water is applied to local pasture land during the summer months. Information on the Petaluma treatment plant, capacity, and operations is included in Section 4.2.3.

SCWA operates and manages the SVCSD treatment plant that provides tertiary disinfected treated recycled water for environmental purposes, dairies, and vineyard irrigation. The SVCSD supplies approximately 1,200 AF of recycled water on an annual basis (SCWA 2005). Because recycled water in the SCWA service area is not used for any urban uses, it does not offset any potable demands. Information on the SVCSD treatment plant, capacity, and operations is included in Section 4.2.4.

Napa SD operates the Soscol Water Recycling Facility near the City of Napa. Napa currently provides disinfected tertiary recycled water to vineyards, commercial landscaping, and golf courses, and to its own reclamation sites during the dry season. In 2005, Napa SD provided about 3,250 AF to customers and spray irrigation, based on the district’s water use rates and irrigated acres (Napa SD 2005). Information on the Napa SD treatment plant, capacity, and operations is included in Section 4.2.5.

2.2.2.4 Future Supply Conditions

Increases in future water supplies to meet increased demands are constrained by a number of factors:

- Wholesale supplies from the Russian River and Dry Creek from SCWA – Sedimentation in Lake Mendocino and Lake Sonoma has gradually reduced storage capacity; modeling estimates approximately 1,000 AF of storage is lost every five years, resulting in a loss of about 3,000 AF by 2020 (NBWA 2005). Additionally, transmission limitations are preventing SCWA from meeting existing seven-day peak demands; this trend would likely worsen without additional conveyance capacity in the future. SCWA water delivery to MMWD is constrained by the transmission system between the Russian River and Marin.

- Napa supplies – The upper limit of Napa's SWP supplies will increase into the future, but will be constrained by SWP statewide allocations. Napa projects that it can meet normal and dry year urban demands through 2020 with existing SWP and local surface water supplies. Napa's estimated year 2020 reliable (dry year) supply from the SWP is 7,880 AFY (City of Napa 2006).

- MMWD local supplies – Water supply from the Lagunitas Creek and Walker Creek watersheds is not likely to change in the future. MMWD is in the planning stages for a local desalination facility. The plant is proposed to initially produce about 5,300 AFY. See Sections 2.3 and 6.1 for more information.

- NMWD supplies – Future supplies from Stafford Lake and the surrounding watershed will remain fairly consistent.

- Groundwater supplies – Under current conditions, the City of Petaluma expects to use no groundwater by 2020 because of quality and supply issues. The City of Sonoma expects future groundwater use to be minimal, about 450 AFY in 2020. VOMWD expects future groundwater use to be minimal, about 784 AFY in 2020 (Booker 2006, SCWA 2001a). In the MST area, it is likely that increases in areas of concentrated groundwater pumping to support agricultural needs will increase saltwater intrusion and decrease water quality (USGS 2003).

- Recycled water supplies – With existing infrastructure, future recycled water production in the study area could, with sufficient funding, increase from almost 9,700 AFY in 2005 to about 15,000 AFY in 2020. LGVSD and Novato SD's production will increase over 2005 levels by about 900 AFY. Petaluma is currently constructing a tertiary recycled water plant. In 2025, Petaluma expects to produce about 3,000 AFY of tertiary water (City of Petaluma 2004). SVCSD is planning to increase recycled water production to 3,000 AFY in 2020 due to the Sonoma Valley Recycled Water Project (SCWA 2005). Napa SD estimates its recycled water production will increase to 4,540 AFY in 2020 for total reuse (Napa SD 2005).

In most years, adequate supplies exist to meet demands on an annual basis. Supplies are strained on a seasonal basis, e.g., surface water flows are lowest in the summer when demand is highest. Future urban growth will likely exacerbate this situation, and the additional sources of water supply to meet future demands are limited. Because of the obstacles to increasing the capacity of existing supplies, the identification and development of new supplies will likely be required to meet future yearly and/or seasonal demands.

2.3 Supply Costs

In absence of the Project, the member agencies face the potential need to develop additional water supplies to meet future demand. There are a number of local and regional alternatives identified for regional water supply to primarily municipal and industrial users. However, few alternatives have been formulated in the study area to directly serve the primarily agricultural demands that would be met by the Project. This section briefly discusses these alternative water supplies, which are described in greater detail as the No Action Alternative in Section 6.1.

SCWA is currently evaluating the Water Supply, Transmission, and Reliability Project which proposes to increase releases from Lake Sonoma to expand diversions from the Russian River. The $647 million project would deliver up to an additional 26,000 AFY and would serve municipal users in Sonoma and Marin Counties who receive water from SCWA (Booker 2008a).[5] NMWD, VOMWD, and City of Sonoma would share a portion of the total project cost.

Although no ocean desalination plants are currently being planned by water agencies within the study area, MMWD, which adjoins the study area, is considering such a plant. Given the uncertainties associated with other developable water supplies, it is possible that desalination may become an option in the study area. The MMWD Bay Water Desalination Project would treat diversions from San Rafael Bay to drinking water standards to increase MMWD's water supply reliability. The proposed project is a 5 mgd plant that could ultimately supply up to 15 mgd. The first phase, a 5 mgd facility, would provide supplemental water supply, particularly during drought years. The estimated project cost of the expandable 5 mgd desalination plant is $121 million (2008 dollars). Operation and maintenance costs range from $4.3 million in average conditions to $7.1 million in drought conditions (MMWD 2007). MMWD assumes the plant will initially produce 5,300 AFY (Kennedy/Jenks Consultants 2007).

No alternative water supplies have been defined in previous studies for bringing water to the MST area of Napa County. The most feasible new water supply alternative, other than bringing recycled water into the area, is to import potable water to the area. Importing water to the MST area has several costs associated with it, including distribution infrastructure, new water supply costs, and a possible NBA expansion. The infrastructure construction costs for a potable water system designed to deliver 1,937 AFY of potable water to the MST area would be about $40 million, similar to the recycled water distribution infrastructure costs. Napa County estimates an additional $8 million in legal and bonding fees would be required to fund the new infrastructure. The City of Napa's future water supply plans do not include the MST

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[5] Costs are shown in 2008 dollars. All costs were escalated to April 2008 dollars using the Building Cost Index.

area; therefore, a new water supply would be needed at additional costs. A recent long-term transfer of water in the Central Valley was priced at $4,000 per AF (Riesenberg 2008). These imported water supplies would likely be wheeled through the NBA, which is currently used at capacity. This option would likely require an increase in the capacity of the NBA, which is estimated at $38 million to bring 1,937 AF to the MST area.

See Section 6.1 for more information on the projects investigated.